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**TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371**

U.S. APPLICATION NO. (If known, see 37 CFR 1.5

not yet known **10/031421**

INTERNATIONAL APPLICATION NO.
PCT/AU00/00865

INTERNATIONAL FILING DATE
20/JULY/2000

PRIORITY DATE CLAIMED
20/JULY/1999

TITLE OF INVENTION
AN ORGANIC WASTE MATERIAL TREATMENT PROCESS

APPLICANT(S) FOR DO/EO/US
THOMASZ RUDAS

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☐ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☒ is attached hereto (required only if not communicated by the International Bureau).
 - b. ☐ has been communicated by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
 - a. ☐ is attached hereto.
 - b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
 - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
 - b. ☐ have been communicated by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). (signed)
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
14. ☐ A SECOND or SUBSEQUENT preliminary amendment.
15. ☐ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. ☒ Other items or information: Cert/Express Mail EL714883945US
PCT/RO/101

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re: Application of **Tomasz RUDAS**

International Application: **PCT/AU00/00865**

International Filing Date: **20/JULY/1999**

U.S. Serial No: **not yet known**

Filed: **submitted herewith**

For: **AN ORGANIC WASTE MATERIAL TREATMENT PROCESS**

Assistant Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Sir:

Prior to examination, please amend the above-identified patent application as follows:

IN THE CLAIMS

Please enter the following complete set of claims. A marked-up version of the claims showing changes made appears after the Remarks.

1 (amended). An organic waste material treatment process for organic waste material received in a vessel comprising the steps of:

- a) subjecting the contents of the vessel to conditions under which aerobic composting of the contents of the vessel will proceed in order to raise the temperature of the contents of the vessel to between 15-75°C to promote anaerobic digestion of the contents;
- b) depleting oxygen in the vessel to create conditions suitable for anaerobic digestion of the contents to proceed;
- c) adding an anaerobic bacterial inoculum to the contents of the vessel;
- d) anaerobically digesting the contents of the vessel;
- e) separating gaseous byproducts from residues resulting from step d);

- f) removing at least a portion of residual water from the vessel;
- g) evenly distributing air to the residues in the vessel to create conditions suitable for aerobic composting of the residues to proceed without agitating the contents of the vessel;
- h) aerobically composting the residues by action of aerobic bacteria; and
- i) recovering compost resulting from step h) from the vessel.

3 (amended). The organic waste material treatment process according to claim 1, characterised in that the temperature of the contents of the vessel is raised to at least 50°C before commencement of step d).

6 (amended). The organic waste material treatment process according to claim 1, characterised in that air is administered to the contents of the vessel before commencement of step a).

7. The organic waste material treatment process according to claim 6, characterised in that air is administered to the contents of the vessel at a pressure of between 1 -1000 kPa above atmospheric pressure to ensure even penetration of the contents of the vessel by the air.

8. The organic waste material treatment process according to claim 7, characterised in that air is administered to the contents of the vessel at a pressure of between 5 - 50 kPa above atmospheric pressure to ensure even penetration of the contents of the vessel by the air.

9 (amended). The organic waste material treatment process according to claim 7, characterised in that air is administered to the contents of the vessel at about 25 kPa above atmospheric pressure.

10 (amended). The organic waste material treatment process according to claim 1, characterised in that water is added to the contents of the vessel to adjust a moisture content of the

contents of the vessel to between about 40 - 60 % wet weight (w/w) before commencement of step a).

13 (amended). The organic waste material treatment process according to claim 1, characterised in that oxygen in the vessel is depleted at step b) by sealing the vessel and ceasing administration of air to the contents of the vessel, thereby providing no further oxygen reserves for aerobic bacteria therein, thus causing the aerobic bacteria to consume the oxygen remaining in the vessel.

17 (amended). The organic waste material treatment process according to claim 1, characterised in that air is administered to the residues at step g) at a pressure of between 1-1000 kPa above atmospheric pressure to ensure even penetration of the residues by the air.

18 (amended). The organic waste material treatment process according to claim 17, characterised in that air is administered to the residues at step g) at a pressure of between 5-50 kPa above atmospheric pressure to ensure even penetration of the residues by the air.

19 (amended). The organic waste material treatment process according to claim 17, characterised in that air is administered to the residues at step g) at a pressure of about 25 kPa above atmospheric pressure to ensure even penetration of the residues by the air.

20 (amended). The organic waste material treatment process according to claim 1, characterised in that the portion of water removed from the vessel in step f) results in a moisture content of the residues of between 40 - 60 % wet weight (w/w).

21 (amended). The organic waste material treatment process according to claim 1, characterised in that the gaseous byproducts separated from the residues in step e) include methane.

22 (amended). The organic waste material treatment process according to claim 1, characterised in that the compost resulting from step h) has been aerobically stabilised.

23 (amended). An organic waste material treatment process for organic waste material received in a plurality of interconnected vessels comprising the steps of:

a) subjecting the contents of the or each vessel to conditions under which aerobic composting of contents will proceed in order to raise the temperature of the contents to between 15-75°C to promote anaerobic digestion of the contents;

b) depleting oxygen in the or each vessel to create conditions suitable for anaerobic digestion of the contents to proceed;

c) adding water received from an interconnected vessel to the or each vessel to create conditions suitable for anaerobic digestion of the contents to proceed in the or each vessel, whereby the contents of the interconnected vessel has already undergone anaerobic digestion and the water contains an anaerobic bacterial inoculum;

d) anaerobically digesting the contents of the or each vessel;

e) separating gaseous byproducts from residues resulting from step d);

f) removing at least a portion of the water from the or each vessel and transferring the portion of the water to another interconnected vessel for use in step c);

g) evenly distributing air to the residues in the or each vessel to create conditions suitable for aerobic composting of the residues to proceed without agitating the contents of the vessel;

h) aerobically composting the residues; and

i) recovering compost resulting from step h) from the or each vessel.

25 (amended). The organic waste material treatment process according to claim 23, characterised in that the temperature of the contents of the or each vessel is raised to at least 50°C before commencement of step d).

28 (amended). The organic waste material treatment process according to claim 23, characterised in that air is administered to the contents of the or each vessel before commencement of step a).

29. The organic waste material treatment process according to claim 28, characterised in that air is administered to the contents of the or each vessel at a pressure of between 1-1000 kPa above atmospheric pressure to ensure even penetration of the contents of the or each vessel by the air.

30. The organic waste material treatment process according to claim 29, characterised in that air is administered to the contents of the or each vessel at a pressure of between 5-50 kPa above atmospheric pressure to ensure even penetration of the contents of the or each vessel by the air.

31 (amended). The organic waste material treatment process according to claim 29, characterised in that air is administered to the contents of the or each vessel at about 25 kPa above atmospheric pressure.

32 (amended). The organic waste material treatment process according to claim 23, characterised in that water is added to the contents of the or each vessel to adjust a moisture content of the contents of the or each vessel to between 40 - 60 % wet weight (w/w) before commencement of step a).

35 (amended). The organic waste material treatment process according to claim 23, characterised in that oxygen in the or each vessel is depleted by sealing the or each vessel and ceasing administration of air to the contents of the or each vessel, thereby providing no further oxygen reserves for aerobic bacteria therein, thus causing the aerobic bacteria to consume the oxygen remaining in the or each vessel.

39 (amended). The organic waste material treatment process according to claim 23, characterised in that air is administered to the residues at step g) at a pressure of between 1-1000 kPa above atmospheric pressure to ensure even penetration of the residues by the air.

40 (amended). The organic waste material treatment process according to claim 39, characterised in that air is administered to the residues at step g) at a pressure of between 5-50 kPa above atmospheric pressure to ensure even penetration of the residues by the air.

41 (amended). The organic waste material treatment process according to claim 39, characterised in that air is administered to the residues at step g) at a pressure of about 25 kPa above atmospheric pressure to ensure even penetration of the residues by the air.

42 (amended). The organic waste material treatment process according to claim 23, characterised in that the portion of water removed from the or each vessel in step f) results in a moisture content of the residues of between 40 - 60 % wet weight (w/w).

43 (amended). The organic waste material treatment process according to claim 23, characterised in that the gaseous byproducts separated from the residues in step e) include methane.

44 (amended). The organic waste material treatment process according to claim 23, characterised in that the compost resulting from step h) has been aerobically stabilised.

45 (amended). A vessel for sequential anaerobic digestion and aerobic composting of organic waste material arranged, in use, to facilitate an organic waste treatment process as claimed in claim 1, comprising a means for receiving organic waste material, first feed means for supplying water to the vessel and second feed means for supplying air to the vessel, wherein the first and second feed means are arranged to evenly distribute water and air to the organic waste material; the vessel being devoid of any internal agitation means.

46. The vessel according to claim 45, characterised in that the first and second feed means include a plurality of feeder lines disposed in at least one wall of the vessel to facilitate the supply of air and water evenly to the organic waste material.

47. The vessel according to claim 45, characterised in that the first and second feed means includes at least one elongate perforated lance depending from an uppermost wall or a lowermost wall of the vessel to facilitate the supply of air and water evenly to the organic waste material.

48 (amended). The vessel according to claim 45, characterised in that the vessel is provided with a gas extraction line to extract gases generated in the interior of the vessel during anaerobic digestion of the organic waste material or to extract surplus gases upon completion of aerobic composting of the organic waste material.

49 (amended). The vessel according to claim 45, characterised in that the vessel is constructed to withstand internal pressures of between about 1-1000 kPa above atmospheric pressure.

50 (amended). The vessel according to claim 45, characterised in that the second feed means supplies pressurised air to the vessel in a range of between about 1-1000 kPa above atmospheric pressure such that the pressurised air evenly penetrates the organic waste material.

51. The vessel according to claim 50, characterised in that the second feed means supplies pressurised air to the vessel in a range of between about 5 - 50 kPa above atmospheric pressure such that the pressurised air evenly penetrates the organic waste material.

52 (amended). The vessel according to claim 50, characterised in that the second feed means supplies pressurised air to the vessel at about 25 kPa above atmospheric pressure.

53 (amended). The vessel according to claim 45, characterised in that the vessel is provided with a drainage means to remove at least a portion of water supplied to the vessel by the first feed means.

54 (amended). An apparatus arranged, in use, to facilitate an organic waste material treatment process as claimed in claim 1, comprising at least one vessel for sequential anaerobic digestion and aerobic composting of organic waste material as claimed in claim 45, a first recirculation means for recirculating gases extracted from the or each vessel to a first storage means, and a second recirculation means for recirculating water extracted from the or each vessel to a second storage means or an interconnected vessel, wherein the organic waste material in the interconnected vessel is undergoing anaerobic digestion.

55. The apparatus according to claim 54, characterised in that the first storage means is a gas storage tank for storing biogas extracted during anaerobic digestion of the organic waste material in the or each vessel.

56 (amended). The apparatus according to claim 54, characterised in that the second storage means is a water storage tank for storing water extracted after anaerobic digestion of the organic waste material in the or each vessel.

57. The apparatus according to claim 56, characterised in that water stored in the water storage tank is recirculated to the interconnected vessel by the second recirculation means, wherein the organic waste material in the interconnected vessel is undergoing anaerobic digestion.

58. The apparatus according to claim 56, characterised in that water stored in the water storage tank is subsequently recirculated back to the vessel by the second recirculation means, wherein a subsequent batch of organic waste material is undergoing anaerobic digestion.

59 (amended). The apparatus according to claim 54, characterised in that the first recirculation means is interconnected to a dewatering tank, the dewatering tank being arranged, in use, for removal of water from the extracted gases.

60. The apparatus according to claim 59, characterised in that the dewatering tank is interconnected to the second recirculation means for recirculating the water removed from the extracted gases to the second storage means or the interconnected vessel.

61 (amended). The apparatus according to claim 54, characterised in that the second storage means is provided with a heating means for heating water stored in the second storage means, the heating means being interconnected by the first recirculation means to the gas storage tank, such that, in use, methane gas stored in the gas storage tank is utilised by the heating means to transfer heat to the water stored in the second storage means.

62 (amended). The apparatus according to claim 54, characterised in that the first recirculation means is interconnected to a heat exchange means, the heat exchange means being arranged, in use, to facilitate transfer of heat energy from hot air extracted from the or each vessel, wherein the organic waste material in the or each vessel is undergoing aerobic composting.

Please delete claims 2, 4, 5, 11, 12, 14, 15, 16, 24, 26, 27, 33, 34, 36, 37 and 38, without prejudice.

REMARKS

This Preliminary Amendment is made to place the subject application in better form for examination in the U.S. Patent and Trademark Office. No new matter has been added. A copy of the published application, identified as International Publication No. WO 01/05729 is attached hereto.

Please enter the Preliminary Amendment prior to examination and before calculating filing fees. A clean copy of the claims as amended is provided for the convenience of the examiner.

Respectfully submitted,

Date: 1/18/02

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Docket No: 283702-13 (D5053-00016)

VERSION WITH MARKINGS TO SHOW CHANGES MADE

1 (amended). An organic waste material treatment process for organic waste material received in a vessel comprising the steps of:

a) subjecting the contents of the vessel to conditions under which aerobic composting of the contents of the vessel will proceed in order to raise the temperature of the contents of the vessel to between 15-75°C to promote anaerobic digestion of the contents;

b) [a)] depleting oxygen [displacing air] in the vessel [and contents thereof with water] to create conditions suitable for anaerobic digestion of the contents to proceed;

c) adding an anaerobic bacterial inoculum to the contents of the vessel;

d) [b)] anaerobically digesting the contents of the vessel;

e) [c)] separating gaseous byproducts from residues resulting from step d) [b)];

f) [d)] removing at least a portion of residual water from the vessel;

g) [e)] evenly distributing [administering] air to the residues in the vessel to create conditions suitable for aerobic composting of the residues to proceed without agitating the contents of the vessel;

h) [f)] aerobically composting the residues by action of aerobic bacteria; and

i) [g)] recovering compost resulting from step h) [f)] from the vessel.

3 (amended). The organic waste material treatment process according to claim 1 [2], characterised in that the temperature of the contents of the vessel is raised to at least 50°C before commencement of step d) [a)].

6 (amended). The organic waste material treatment process according to claim 1 [4 or claim 5], characterised in that air is administered to the contents of the vessel before commencement of step a).

9 (amended). The organic waste material treatment process according to claim 7 [or claim 8], characterised in that air is administered to the contents of the vessel at about 25 kPa above atmospheric pressure.

10 (amended). The organic waste material treatment process according to claim 1 [any one of claims 2 to 9], characterised in that water is added to the contents of the vessel to adjust a moisture content of the contents of the vessel to between about 40 - 60 % wet weight (w/w) before commencement of step a).

13 (amended). The organic waste material treatment process according to claim 1 [11 or claim 12], characterised in that oxygen in the vessel is depleted at step b) by sealing the vessel and ceasing administration of air to the contents of the vessel, thereby providing no further oxygen reserves for aerobic bacteria therein, thus causing the aerobic bacteria to consume the oxygen remaining in the vessel.

17 (amended). The organic waste material treatment process according to claim 1 [any one of claims 1 to 16], characterised in that air is administered to the residues at step g) at a pressure of between 1-1000 kPa above atmospheric pressure to ensure even penetration of the residues by the air[, thereby facilitating aerobic composting of the residues in step e)].

18 (amended). The organic waste material treatment process according to claim 17, characterised in that air is administered to the residues at step g) at a pressure of between 5-50 kPa above atmospheric pressure to ensure even penetration of the residues by the air[, thereby facilitating aerobic composting of the residues].

19 (amended). The organic waste material treatment process according to claim 17 [or claim 18], characterised in that air is administered to the residues at step g) at a pressure of about 25 kPa above atmospheric pressure to ensure even penetration of the residues by the air[, thereby facilitating aerobic composting of the residues].

20 (amended). The organic waste material treatment process according to claim [any one of claims] 1 [to 19], characterised in that the portion of water removed from the vessel in step f) [d)] results in a moisture content of the residues of between 40 - 60 % wet weight (w/w).

21 (amended). The organic waste material treatment process according to claim [any one of claims] 1 [to 20], characterised in that the gaseous byproducts separated from the residues in step e) [c)] include methane.

22 (amended). The organic waste material treatment process according to claim [any one of claims] 1 [to 21], characterised in that the compost resulting from step h) [f)] has been aerobically stabilised.

23 (amended). An organic waste material treatment process for organic waste material received in a plurality of interconnected vessels comprising the steps of:

a) subjecting the contents of the or each vessel to conditions under which aerobic composting of contents will proceed in order to raise the temperature of the contents to between 15-75°C to promote anaerobic digestion of the contents;

b) depleting oxygen in the or each vessel to create conditions suitable for anaerobic digestion of the contents to proceed;

c) [a)] adding [displacing air in at least one of the vessels and contents thereof with] water received from an interconnected vessel to the or each vessel to create conditions suitable for anaerobic digestion of the contents to proceed in the or each vessel, whereby the contents of the interconnected vessel has [having] already undergone anaerobic digestion and the water contains an anaerobic bacterial inoculum;

d) [b)] anaerobically digesting the contents of the or each vessel;

e) [c)] separating gaseous byproducts from residues resulting from step d) [b)];

f) [d)] removing at least a portion of the water from the or each vessel and transferring the portion of the water to another interconnected vessel for use in step c) [a)];

g) [e)] evenly distributing [administering] air to the residues in the or each vessel to create conditions suitable for aerobic composting of the residues to proceed without agitating the contents of the vessel;

h) [f)] aerobically composting the residues; and

i) [g)] recovering compost resulting from step h) [f)] from the or each vessel.

25 (amended). The organic waste material treatment process according to claim 23 [24], characterised in that the temperature of the contents of the or each vessel is raised to at least 50°C before commencement of step d) [a)].

28 (amended). The organic waste material treatment process according to claim 23 [26 or claim 27], characterised in that air is administered to the contents of the or each vessel before commencement of step a).

31 (amended). The organic waste material treatment process according to claim 29 [or claim 30], characterised in that air is administered to the contents of the or each vessel at about 25 kPa above atmospheric pressure.

32 (amended). The organic waste material treatment process according to claim [any one of claims] 23 [to 31], characterised in that water is added to the contents of the or each vessel to adjust a moisture content of the contents of the or each vessel to between 40 - 60 % wet weight (w/w) before commencement of step a).

35 (amended). The organic waste material treatment process according to claim 23 [33 or claim 34], characterised in that oxygen in the or each vessel is depleted by sealing the or each vessel and ceasing administration of air to the contents of the or each vessel, thereby providing no further oxygen reserves for aerobic bacteria therein, thus causing the aerobic bacteria to consume the oxygen remaining in the or each vessel.

39 (amended). The organic waste material treatment process according to claim 23 [any one of claims 24 to 38], characterised in that air is administered to the residues at step g) at a pressure of between 1-1000 kPa above atmospheric pressure to ensure even penetration of the residues by the air[, thereby facilitating aerobic composting of the residues in step e)].

40 (amended). The organic waste material treatment process according to claim 39, characterised in that air is administered to the residues at step g) at a pressure of between 5-50 kPa above atmospheric pressure to ensure even penetration of the residues by the air[, thereby facilitating aerobic composting of the residues].

41 (amended). The organic waste material treatment process according to claim 39 [or claim 40], characterised in that air is administered to the residues at step g) at a pressure of about 25 kPa above atmospheric pressure to ensure even penetration of the residues by the air[, thereby facilitating aerobic composting of the residues].

42 (amended). The organic waste material treatment process according to claim 23 [any one of claims 24 to 41], characterised in that the portion of water removed from the or each vessel in step f) [d)] results in a moisture content of the residues of between 40 - 60 % wet weight (w/w).

43 (amended). The organic waste material treatment process according to claim 23 [any one of claims 24 to 42], characterised in that the gaseous byproducts separated from the residues in step e) [c)] include methane.

44 (amended). The organic waste material treatment process according to claim 23 [any one of claims 24 to 43], characterised in that the compost resulting from step h) [f)] has been aerobically stabilised.

45 (amended). A vessel for sequential anaerobic digestion and aerobic composting of organic waste material arranged, in use, to facilitate an organic waste treatment process as claimed in claim 1, comprising a means for receiving organic waste material, first feed means for supplying water to the vessel and second feed means for supplying air to the vessel, wherein the first and second feed means are arranged to evenly distribute water and air to the organic waste material; the vessel being devoid of any internal agitation means.

48 (amended). The vessel according to claim [any one of claims] 45 [to 47], characterised in that the vessel is provided with a gas extraction line to extract gases generated in the interior of the vessel during anaerobic digestion of the organic waste material or to extract surplus gases upon completion of aerobic composting of the organic waste material.

49 (amended). The vessel according to claim [any one of claims] 45 [to 48], characterised in that the vessel is constructed to withstand internal pressures of between about 1-1000 kPa above atmospheric pressure.

50 (amended). The vessel according to claim [any one of claims] 45 [to 49], characterised in that the second feed means supplies pressurised air to the vessel in a range of between about 1-1000 kPa above atmospheric pressure such that the pressurised air evenly penetrates the organic waste material.

52 (amended). The vessel according to claim 50 [or claim 51], characterised in that the second feed means supplies pressurised air to the vessel at about 25 kPa above atmospheric pressure.

53 (amended). The vessel according to claim [any one of claims] 45 [to 52], characterised in that the vessel is provided with a drainage means to remove at least a portion of water supplied to the vessel by the first feed means.

54 (amended). An apparatus arranged, in use, to facilitate an organic waste material treatment process as claimed in claim [any one of claims] 1 [to 44], comprising at least one vessel for sequential anaerobic digestion and aerobic composting of organic waste material as claimed in claim [any one of claims] 45 [to 53], a first recirculation means for recirculating gases extracted from the or each vessel to a first storage means, and a second recirculation means for recirculating water extracted from the or each vessel to a second storage means or an interconnected vessel, wherein the organic waste material in the interconnected vessel is undergoing anaerobic digestion.

56 (amended). The apparatus according to claim 54 [or claim 55], characterised in that the second storage means is a water storage tank for storing water extracted after anaerobic digestion of the organic waste material in the or each vessel.

59 (amended). The apparatus according to claim [any one of claims] 54 [to 58], characterised in that the first recirculation means is interconnected to a dewatering tank, the dewatering tank being arranged, in use, for removal of water from the extracted gases.

61 (amended). The apparatus according to claim [any one of claims] 54 [to 60], characterised in that the second storage means is provided with a heating means for heating water stored in the second storage means, the heating means being interconnected by the first recirculation means to the gas storage tank, such that, in use, methane gas stored in the gas storage tank is utilised by the heating means to transfer heat to the water stored in the second storage means.

62 (amended). The apparatus according to claim [any one of claims] 54 [to 61], characterised in that the first recirculation means is interconnected to a heat exchange means, the heat exchange means being arranged, in use, to facilitate transfer of heat energy from hot air extracted from the or each vessel, wherein the organic waste material in the or each vessel is undergoing aerobic composting.

Please delete claims 2, 4, 5, 11, 12, 14, 15, 16, 24, 26, 27, 33, 34, 36, 37 and 38, without prejudice.

PH1\916675.1

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY
STATUS (37 CFR 1.9(F) AND 1.27(C)) - SMALL BUSINESS CONCERN**

Applicant or Patentee: TOMASZ RUDAS
Serial or Patent No.: _____ **Attorney Docket No.:** 283702-5

Filed or Issued: _____
For: _____

I hereby declare that I am

- ☐ **the owner of the small business concern identified below:**
- ☐ **an official of the small business concern empowered to act on behalf of the concern identified below:**

NAME OF CONCERN ORGANIC RESOURCE TECHNOLOGIES
LIMITED

ADDRESS OF CONCERN Unit 11, 4-8 Queen Street, Bentley 6102, Western
Australia, AUSTRALIA

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 1.21.3-18, and reproduced in 37 CFR 1.9(d), for the purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention entitled An Organic Waste Material Treatment Process of inventor(s) Tomasz Rudas, described in

- ☒ **the specification filed herewith.**
- ☐ **application serial no. _____, filed _____**
- ☐ **patent no. _____, issued _____.**

If the rights held by the above identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed below* and no rights to the invention are held by any person, other than the inventor, who could not qualify as a small business concern under 37 CFR 1.9(d) or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

*NOTE: Separate verified statements are required from each named person, concern or organization having rights to this invention averring to their status as small entities. (37 CFR 1.27).

FULL NAME _____
ADDRESS _____

☐ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b)).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING Tomasz Rudas

TITLE OF PERSON DIRECTOR ORGANIC RESOURCE TECHNOLOGIES LTD

ADDRESS OF PERSON SIGNING Unit 11, 4-8 Queen Street, Bentley 6102, Western Australia, AUSTRALIA

SIGNATURE  DATE 15/01/02

2/ptn

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TITLE

"AN ORGANIC WASTE MATERIAL TREATMENT PROCESS"

FIELD OF THE INVENTION

The present invention relates to an organic waste material treatment process.

BACKGROUND OF THE INVENTION

It is well known that degradation of solid organic waste material to a bioactive, stabilised end product such as compost for gardens, can be achieved by treating the solid organic waste material under either anaerobic or aerobic conditions in which anaerobic or aerobic microorganisms, respectively, metabolise the waste material to the end product.

Aerobic decomposition of solid organic waste material takes place in the presence of oxygen. Energy produced during aerobic decomposition is released as heat, the temperature of the material frequently rising to 75°C under ambient conditions. The resulting solid end product is generally rich in nitrates which is a readily bioavailable source of nitrogen for plants. Thus the bio-available resultant end product is an excellent fertilising material for gardens and has commercial value as such.

Anaerobic digestion of solid organic waste takes place in the absence of oxygen.

Typically, the solid organic waste must be heated to a mesophilic or thermophilic temperature range in order for anaerobic microbial metabolism to be optimised. Energy produced during anaerobic digestion is conserved as biogas, predominantly methane and carbon dioxide. The resultant solid end product is generally rich in ammonium salts.

Ammonium salts are not readily bio-available for uptake by plants. It is known, therefore, to treat residues, resulting from anaerobic digestion, with conditions under which aerobic decomposition will proceed. Thus, the material is converted to one rich in nitrates and which is of commercial value.

- 5 Systems have generally been designed to cater discretely for each type of degradation, although some systems have been designed to combine both anaerobic and aerobic decomposition processes.

German Patent Number 4440750 relates to an apparatus for raw material and energy recovery from biomass which has an anaerobic fermentation unit, an aerobic composting unit, a gasification unit and a power generating plant. The apparatus utilises byproducts from the anaerobic fermentation unit and the aerobic composting unit to work synergistically to provide reduced amounts of residues and to improve raw material and energy production.

10 International Patent Application Number WO 94/24071 discloses treatment of organic bioresidues especially from municipal and industrial wastes, including raw and/or cooked food residues, agricultural wastes and/or plant vegetable components. The bioresidues are first homogenised, fermented in an anaerobic reactor wherein the resulting biogas is removed, and then the residual solids are transferred to a composting chamber.

20 These and other similar systems provide discrete and separate chambers or vessels for aerobic decomposition and anaerobic digestion, respectively. Material which has undergone one set of conditions is transferred to a separate location to undergo a secondary processing phase. The transfer of material from one location to another is not efficient in terms of time, costs and labour.

The present invention seeks to overcome, at least in part, some of the aforementioned disadvantages.

SUMMARY OF THE INVENTION

5 In accordance with a first aspect of the present invention there is provided an organic waste material treatment process for organic waste material received in a vessel comprising the steps of:

- a) displacing air in the vessel and contents thereof with water to create conditions suitable for anaerobic digestion of the contents to proceed;
- 10 b) anaerobically digesting the contents of the vessel by action of anaerobic bacteria;
- c) separating gaseous byproducts from residues resulting from step b);
- d) removing at least a portion of the water from the vessel;
- e) administering air to the residues in the vessel to create conditions suitable for aerobic composting of the residues to proceed;
- 15 f) aerobically composting the residues by action of aerobic bacteria; and
- g) recovering compost resulting from step f) from the vessel.

In accordance with a second aspect of the present invention there is provided an organic waste material treatment process for organic waste material received in a plurality of interconnected vessels comprising the steps of:

- 20 a) displacing air in at least one of the vessels and contents thereof with water received from an interconnected vessel to create conditions suitable for anaerobic digestion of the contents to proceed in the or each vessel, the contents of the interconnected vessel having already undergone anaerobic digestion;

- b) anaerobically digesting the contents of the or each vessel;
- c) separating gaseous byproducts from residues resulting from step b);
- d) removing at least a portion of the water from the or each vessel and transferring the portion of the water to another interconnected vessel for use in step a);
- 5 e) administering air to the residues in the or each vessel to create conditions suitable for aerobic composting of the residues to proceed;
- f) aerobically composting the residues; and
- g) recovering compost resulting from step f) from the or each vessel.

In accordance with a third aspect of the present invention there is provided a vessel for
10 anaerobic digestion and aerobic composting of organic waste material comprising a means for receiving organic waste material, first feed means for supplying water to the vessel and second feed means for supplying air to the vessel, wherein the first and second feed means are arranged to evenly distribute water and air to the organic waste material; the vessel being devoid of any internal agitation means.

15 In accordance with a fourth aspect of the present invention there is provided an apparatus arranged , in use, to facilitate an organic waste material treatment process, comprising at least one vessel for sequential anaerobic digestion and aerobic composting of organic waste material, a first recirculation means for recirculating gases extracted from the or each vessel to a first storage means and a second recirculation means for recirculating
20 water extracted from the or each vessel to a second storage means or an interconnected vessel, wherein the organic waste material in the interconnected vessel is undergoing anaerobic digestion.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 is a schematic diagram of an apparatus, arranged in use, to house organic waste material and to facilitate therein a sequential decomposition process comprising an anaerobic digestion stage and an aerobic composition stage, in accordance with the present invention; and

Figure 2 is a schematic diagram of a plurality of vessels shown in Figure 1, interconnected by a first and second recirculation means, wherein each vessel is arranged, in use, to house organic waste material and to facilitate a sequential decomposition process therein, and the first and second recirculation means is arranged, in use, to recirculate byproducts from each vessel to an adjoining vessel in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In Figure 1 of the accompanying drawings there is shown an apparatus 10, arranged in use, to house organic waste material and to facilitate a sequential decomposition process, comprising an anaerobic digestion stage and an aerobic composting stage, therein.

The apparatus 10 includes an air tight pressurised vessel 20, arranged, in use, to house organic waste material. Preferably, the vessel 20 is constructed from a rigid, chemically inert material with good structural integrity such as steel or concrete. Preferably, the vessel 20 operates in a pressure range of between about 1-1000 kPa above atmospheric pressure.

An uppermost wall 22 of the vessel 20 is provided with a receival hatch 24 which is arranged in use to remain in an open position when organic waste material is loaded or unloaded from the vessel 20. The receival hatch 24 is arranged in use to remain in a closed position when the organic waste material is undergoing the sequential decomposition process.

The organic waste material may be loaded into the vessel 20 by an auger loader 30 and a belt conveyor 40 as shown in Figure 1. It will be appreciated, however, that any convenient conveying and loading system may be used to load the vessel 20 with organic waste material

The vessel 20 is also provided with an extraction hatch 27 which is disposed in a wall 21 of the vessel 20. The extraction hatch 27 is arranged in use to remain in an open position when an end product of the sequential decomposition process is unloaded from the vessel. The extraction hatch 27 is arranged in use to remain in a closed position during the sequential decomposition process.

The vessel 20 is provided with a plurality of feeder lines 26 which are arranged, in use, to deliver air or water to the vessel 20. It is envisaged that air will be delivered to the vessel 20 under a positive pressure of between about 1-1000 kPa above atmospheric pressure. It has been found that operating air pressures inside the vessel of about between 1-1000 kPa above atmospheric pressure facilitate a more efficient air penetration and distribution of air into the material contents of the vessel 20. The feeder lines 26 are also arranged to drain the vessel 20 of excess water under negative pressure. The feeder lines 26 are disposed in at least one wall 21 of the vessel 20 such that the water or the air is evenly distributed in the organic waste material housed by the vessel 20. The even distribution of

water or air eliminates the necessity for an agitation means within the vessel 20 to homogenise conditions therein. It is envisaged, however, that in the case of a large industrial scale operation where the volume of the vessel 20 is very large, it may be more convenient to install an agitation means within the vessel 20 to assist homogenise conditions therein

The feeder lines 26 are connected with a control line 28 which is arranged to control the flow and distribution of water and air to and from the vessel 20 at appropriate stages of the sequential decomposition process.

In an alternative embodiment of the invention the vessel 20 is provided with at least one elongate perforated lance which is also arranged in use to deliver air or water to the vessel 20 in a similar manner to the feeder lines 26. It is envisaged that the perforations will be equidistantly spaced apart from one another over the length of the lance in order to promote even distribution of air and water into the vessel 20. The lance is arranged to extend from the uppermost wall 22 or the lowermost wall 21 of the vessel 20. The vessel 20 is additionally provided with a drainage means to drain excess water from the vessel 20 under negative pressure.

The apparatus 10 is provided with a first and a second recirculation lines 62, 64. The first recirculation line 62 is provided with a first pump 61 which is arranged to facilitate recirculation of gas through the apparatus 10. Air from an external source may also be received into the first recirculation line 62 via a first port 65. The second recirculation line 64 is provided with a second pump 63 which is arranged to facilitate recirculation of water through the apparatus 10. Water from an external source may also be received into the second recirculation line 64 via a second port 66. The second port 66 is also arranged

to receive biological or chemical additives, such as a bacterial inoculum, enzymes and pH buffers.

The first and second recirculation lines 62, 64 are interconnected with the vessel 20 by the control line 28 and the feeder lines 26.

- 5 The uppermost wall 22 of the vessel 20 is also provided with a gas extraction line. The gas extraction line 50 interconnects the vessel 20 and a de-watering tank 60. The gas extraction line 50 is arranged, in use, to extract gases generated in the interior of the vessel 20 during an anaerobic digestion stage of the sequential decomposition process, or to extract air from the head space of the vessel 20 during an aerobic composting stage of the sequential decomposition process

The de-watering tank 60 is arranged, in use, to remove water from the extracted gases.

The de-watering tank 60 is connected with the first recirculation lines 62 and a de-watering line 67. In this way, the first recirculation line 62 facilitates the recirculation of de-watered gas through the apparatus 10. The de-watering line 67 is arranged in use to recirculate the water which has been removed from the gas through the apparatus 10.

The de-watering line 67 is connected to the second recirculation line 64.

- The apparatus 10 is provided with a biofilter 70 which is interconnected with the first recirculation line 62 by an exit line 72. The biofilter 70 is arranged in use to scrub the recirculating air of odorous emissions resulting from the anaerobic digestion and aerobic composting stages of the sequential composting process prior to exhaustion of the scrubbed recirculating air into the atmosphere.

The apparatus 10 is also provided with a gas storage tank 80 which is interconnected with the first recirculation line 62 by a first storage line 82. The gas storage tank 80 is

arranged in use to receive biogas, predominantly a mixture of methane and carbon dioxide, generated during the anaerobic digestion stage of the sequential decomposition process. It will be understood that the received biogas will have been treated in the de-watering tank 60 prior to storage in the gas storage tank 80.

5 The gas storage tank 80 is interconnected with a power generator 85 by a generator line 84. The power generator 85 is arranged to convert the biogas to electrical power, wherein the electrical power may be distributed to other components of the apparatus 10 as required. Any excess electrical power generated by the generator 85 could be delivered to an external power grid.

10 As shown in Figure 1, the apparatus 10 also includes a water heater tank 90. The water heater tank 90 is interconnected with the de-watering tank 60 by the de-watering line 67. The water heater tank 90 is arranged to receive water from the de-watering tank 60 via the de-watering line 67 and from the second port 66. The water heater tank 90 is also interconnected with the gas storage tank 80 by a first delivery line 87. The water heater
15 tank 90 is provided with means to convert the biogas received from the first delivery line 87 to heat in order to control the temperature of the water in the water heater tank 90.

It will be understood that water in the water heater tank 90 is maintained at a temperature of 15°C to 75°C. The water is arranged, in use, to be recirculated through the apparatus
10 via the second recirculation line 64, the control line 28 and the feeder lines 26 into the
20 vessel 20 during the anaerobic digestion stage of the sequential decomposition process. Delivery of water heated to a temperature range at which anaerobic microbial activity is optimised assists the anaerobic digestion stage of the sequential decomposition process.

As shown in Figure 1, the apparatus 10 also includes a water storage tank 92. The water storage tank 92 is connected to the second recirculation line 64. The water storage tank 92 is arranged to receive and store water extracted from the vessel 10 after completion of the anaerobic digestion stage of the sequential decomposition process.

- 5 The apparatus 10 is also provided with a heat exchange means 95 which is connected with the gas extraction line 50. The heat exchange means 95 is arranged in use to utilise energy from hot air extracted during the aerobic composting stage. The energy from the extracted hot air is used to heat water flowing through the second recirculation line 64. It will be appreciated that the extracted hot air may also be recirculated through the
- 10 apparatus 10 via the first recirculation line 62, the control line 28 and the feeder lines 26 into the vessel 20 before the commencement of the anaerobic digestion stage in order to heat the organic waste material therein. Preheating the organic waste material to a temperature range of between 15°C and 75°C at which anaerobic microbial activity is optimised assists the anaerobic digestion stage of the sequential decomposition process.
- 15 It will be understood that the heat exchange means 95 operates most efficiently when included in a plant where a plurality of vessels 10 are configured in a sequential batch configuration.

In Figure 2 of the accompanying drawings there is shown an apparatus 100 including a plurality of vessels 20 as described in Figure 1 wherein like numerals and symbols refer

20 to like parts throughout. The vessels 20 are interconnected with one another by the first and second recirculation lines 62 and 64

In addition to the functions of the first recirculation line 62 previously described in relation to Figure 1, the first recirculation line 62 is also arranged to facilitate

recirculation of gas extracted from one vessel 20 to the control line 28 and feeder lines 26 of another vessel 20. For example, hot air extracted from one vessel undergoing the aerobic composting stage can be recirculated to another vessel 20 which may require heat to initiate the aerobic composting stage. Alternatively, the organic waste material housed by another vessel 20 may be heated by the recirculated hot air before commencement of the anaerobic digestion stage in that vessel 20.

In addition to the functions of the second recirculation line 64 previously described in relation to Figure 1, the second recirculation line 64 is arranged to facilitate recirculation of water removed from one vessel 20 to the control line 28 and feeder lines of another vessel 20. For example, water removed from one vessel 20 after completion of the anaerobic digestion stage can be recirculated to another vessel 20 which may require an increased water content to commence the anaerobic digestion stage.

It will be appreciated that the contents of each vessel 20 may be at varying stages of the sequential decomposition process. Preferably, each vessel 20 is configured to form a sequential batch to facilitate continuous operation of the sequential decomposition process of the present invention.

A multiple vessel system is configured such that one vessel 20 is filled with organic waste material while another is being emptied, the remaining vessels 20 in the multiple vessel system 100 being arranged to be at various stages of the sequential decomposition process.

It will also be appreciated that additional vessels 20 may be interconnected to the apparatus 100 by the first and second recirculation lines 62 and 64 to increase processing volumes of the apparatus 100.

As shown in Figure 2, there is provided a gas extraction line 52 for air removed from each vessel 20 during the aerobic composting stage, and an additional gas extraction line 52a for the extraction of biogas from the contents of each vessel 20 which are generated during the anaerobic digestion stage.

- 5 The sequential decomposition process of organic waste material will now be described with reference to the apparatus 10 as shown in Figure 1 and the apparatus 100 as shown in Figure 2.

The sequential decomposition process of organic waste material is a two stage process including an anaerobic digestion stage followed by an aerobic composting stage.

- 10 Preferably, the organic waste material undergoes a preliminary aerobic composting pre-conditioning stage followed by a preliminary digestion pre-conditioning stage before commencement of the anaerobic digestion stage and the aerobic composting stage.

- The organic waste material is typically sized and mixed to effect a substantially homogenous mixture. It is understood that organic waste material refers to solid organic waste material, comprising vegetable matter; household and municipal organic waste, including cellulosic material such as waste paper; industrial organic waste; and agricultural organic waste, for example animal manures. Typically, the C:N ratio of the organic waste material is greater than 20. Consistency of the material is preferably optimised for optimum water flow through the contents in the vessel 20 during the preliminary anaerobic digestion pre-conditioning stage and the anaerobic digestion stage, and optimum air flow through the contents in the vessel 20 during the preliminary aerobic composting pre-conditioning stage and the aerobic composting stage. The receival hatch 24 of the vessel 20 is opened, and the auger loader 30 and belt conveyor 40

deliver the homogenised waste material into the vessel 20 until the vessel 20 is substantially full. The receival hatch 24 is then closed to seal the vessel 20.

The preliminary aerobic composting pre-conditioning stage comprises the steps of:

- 1) adjusting the moisture content of the waste material to 40-60% of the wet weight (w/w);
- 2) pumping air into waste material in the vessel 20; and
- 3) decomposition of the waste material by aerobic bacteria.

Water from an external source at the second port 66 is pumped by the second pump 63 through the second recirculation line 64 and into the vessel 20 via the control line 28 and the feeder lines 26. The feeder lines 26 evenly distribute the water through the organic waste material such that the moisture content of the waste material ranges from 40-60% wet weight (w/w) throughout the contents of the vessel 20. Alternatively, the moisture content may be adjusted prior to loading the vessel 20 with the waste material.

Air from an external source at the first port 65 is then pumped under pressure within the range 1-1000 kPa above atmospheric pressure by the first pump 61 through the first recirculation line 62 of the apparatus 10 and into the vessel 20 via the control line 28 and the feeder lines 26. The feeder lines 26 evenly distribute the air through the organic waste material such that the organic waste material is substantially evenly aerated.

It will be appreciated that initially during the preliminary aerobic pre-conditioning composting stage air is optionally extracted from the headspace in the vessel 20 between the organic waste material and the uppermost wall 22 of the vessel 20, via the gas extraction line 50. The extracted air may optionally have water removed therefrom in the

de-watering tank 60 before the air is pumped through the first recirculation line 62 by the first pump 61 back into the vessel 20.

Alternatively, air extracted by the means described above may be sourced from another vessel 20.

- 5 Under the conditions described above, indigenous aerobic bacteria present in the organic waste material begin to metabolise and break down the organic waste material. The preliminary aerobic composting pre-conditioning stage operates in a temperature range of 15°C to 75°C for a period between 1 to 28 days.

- The purpose of the preliminary aerobic composting pre-conditioning stage is to raise the temperature of the contents of the vessel 20 to a temperature within a range of 15°C - 75°C, preferably over 50°C. The temperature range of 15°C - 75°C is a preferred range in which the preliminary anaerobic digestion pre-conditioning stage and the anaerobic digestion stage proceeds at optimum efficiency. In this way, the present invention avoids the necessity of reliance on a fuel driven heating means to raise the temperature of the contents within the vessel 20 to the optimal temperature for commencement of the preliminary anaerobic digestion pre-conditioning stage and/or the anaerobic digestion stage.

- Preferably, the preliminary aerobic composting pre-conditioning stage comprises creating conditions under which the contents of the vessel 20 undergoes aerobic composting. Heat generated by the aerobic composting of the contents of the vessel 20 raises the ambient temperature thereof to a temperature range of 15°C - 75°C at which point the

conditions within the vessel 20 are changed by an operator such that the preliminary anaerobic digestion pre-conditioning stage or the anaerobic digestion stage commences.

It will be understood that other suitable alternative means to raise the temperature of the contents of the vessel 20 may be substituted for the preliminary aerobic composting pre-

5 conditioning stage. For example, heated air or steam from a convenient accessible geothermal source may be pumped into the contents of the vessel 20 to raise the temperature therein to the desired range for commencement of the preliminary anaerobic digestion pre-conditioning stage. Alternatively, referring to the apparatus 100 in Figure 2, heated air extracted from a vessel 20 in which the contents are undergoing the aerobic
10 composting stage may be re-circulated to another vessel 20 via the first recirculation line 62 in order to heat the contents of that vessel 20 to a desired temperature range.

The preliminary anaerobic digestion pre-conditioning stage comprises the steps of:

- 1) sealing the vessel 20 to prevent ingress of air into the vessel 20; and
- 2) depletion of oxygen in the sealed vessel 20.

15 The vessel 20 is sealed when the temperature of the contents of the vessel 20 is in the range of 15°C - 75°C, preferably greater than or equal to 50°C. It is well understood that temperatures in the range of 15°C - 75°C are desirable for anaerobic digestion operating conditions. The vessel 20 is sealed by ceasing to pump and/or circulate air through the feeder lines 26 and the control line 28 to the vessel 20.

20 Oxygen levels will eventually be depleted in the sealed vessel 20 by action of the aerobic bacteria therein. Typically, the metabolic processes of the aerobic bacteria converts the oxygen to carbon dioxide. When the oxygen levels in the vessel 20 are sufficiently

depleted, the anaerobic digestion stage of the sequential decomposition process commences.

The purpose of the preliminary anaerobic digestion pre-conditioning stage is to facilitate the depletion of oxygen inside the vessel prior to addition of an anaerobic inoculum and the commencement of the anaerobic digestion stage.

Biogas is produced at the commencement of and during the anaerobic digestion stage. A mixture of methane and oxygen in the vessel 20 would provide a combustible and potentially explosive gas mixture. Furthermore, the introduction of an anaerobic inoculum into a vessel 20 having a moderate to high oxygen level would prove fatal to the anaerobic inoculum since most anaerobic bacteria are intolerant to oxygen.

Thus, it is an advantage of the preliminary anaerobic digestion pre-conditioning stage to deplete oxygen levels in the sealed vessel 20 before commencement of the anaerobic digestion stage.

When the oxygen level drops to below accepted standards the anaerobic digestion stage of the sequential decomposition process can commence.

The anaerobic digestion stage comprises the steps of:

- 1) adjusting the moisture content of the waste material to 50-95% wet weight (w/w);
and
- 2) digestion of the waste material by anaerobic bacteria.

Water from an external source at the second port 66 is received through the second recirculation line 64 and pumped by the second pump 63 into the vessel 20 via the control line 28 and the feeder lines 26. The feeder lines 26 evenly distribute the water through the organic waste material such that the moisture content of the waste material

ranges from 50-95% wet weight (w/w) throughout the contents of the vessel 20. It will be appreciated that the water from the external source may have been mixed with a bio-sludge to act as an anaerobic bacterial inoculum. Alternatively, water removed from another vessel 20 which has undergone the anaerobic digestion stage may be recirculated
5 by the second recirculation line 64 into the present vessel 20. In this way, process water from one anaerobic digestion can be used to inoculate the contents of an interconnected vessel 20 undergoing the anaerobic digestion stage in a multiple vessel system 100.

The anaerobic digestion stage operates in a mesophilic to thermophilic temperature range between 15°C -75°C, preferably over 50°C for a period between 4 to 20 days.

10 Methane and carbon dioxide gases are generated during the anaerobic digestion stage. They are extracted under pressure through the gas extraction line 50 and delivered to the de-watering tank 60 where water is removed from the extracted gases. The extracted gases are then delivered through the first recirculation line 62 to the gas storage tank 80 via the first storage line 82. The gas may then be converted to electrical power by the
15 power generator 85, or alternatively, used to heat water in the water heater tank 90.

The water which is removed from the extracted gases in the de-watering tank 60 is then delivered to the heater tank 90 by the de-watering line 67. The water may be heated in the water heater tank 90. The heated water may also be recirculated by the second recirculation line 64, the control line 28 and the feeder lines 26 back into the vessel 20 for
20 a subsequent anaerobic digestion stage, of another batch of organic waste material. In this way the heat and electricity indirectly generated by the anaerobic digestion stage can be utilised to subsidise energy requirements in interconnected vessels 20 or used in

subsequent stages of the sequential decomposition process occurring at a later time in the same vessel 20. It has been found that during the anaerobic digestion stage the amount of volatile solids is reduced and nitrogen content in the contents of the vessel 20 is concentrated.

- 5 Following completion of the anaerobic digestion stage conditions within the vessel 20 are altered such that the aerobic composting stage may commence.

The aerobic composting stage comprises the steps of:

- 1) reducing moisture content within the vessel; and
- 2) aerating the contents of the vessel.

- 10 Excess water is removed from the vessel 20 via the feeder lines 26 and the control line 28 under gravity drainage combined with application of a negative pressure to draw excess water into the second recirculation line 64. Thus, the moisture content of the contents within the vessel 20 is adjusted to 40 to 60% w/w. It will be appreciated that the moisture content can also be lowered to the desired range by pumping warm air sourced
- 15 from another vessel 20 in a multiple vessel system 100 undergoing aerobic composting through the control line 28 and the feeder lines 26 into the vessel 20. The excess water is recirculated into the water storage tank 92. Alternatively, the excess water may be recirculated by the second recirculation line 64 into another vessel 20 in a multiple vessel system 100 whose contents are about to undergo the anaerobic digestion stage.
- 20 The contents of the vessel 20 are aerated by pumping air through the control line 28 and the feeder lines 26 into the vessel 20. It will be appreciated that the conditions for the aerobic composting stage are the same as for the preliminary aerobic composting pre-conditioning stage described previously.

Adjustment to the operating parameters may be made by dosing the vessel contents through the second port 66 as previously described.

It will be appreciated that heat generated from the aerobic composting stage may be used to facilitate the formation of mesophilic to thermophilic conditions for an anaerobic digestion stage or an aerobic composition stage occurring in another interconnected vessel 20.

Upon completion of the aerobic composting stage, the resulting compost will be deposited from the vessel 20 through the extraction hatch 27, loaded and packed for sale.

The resulting compost is relatively dry and has little odour. Nitrogen content in the resulting material is fixed as ammonium. Typically, the C:N ratio of the resulting compost is ≤ 20 .

The present invention will now be further illustrated with reference to the following Example

EXAMPLE

Organic waste material consisting of shredded newspaper (6.75kg), shredded cardboard (6.75kg), grass clippings (4.4kg), garden waste (30.4kg) and chicken manure (38.3 kg) was blended and received in a 0.8m³ vessel. The C:N ratio of the organic waste material was 25.6.

The contents of the vessel were subjected to a preliminary aerobic composting pre-conditioning stage wherein air was administered to the contents of the vessel at a flow rate of 300L/hr. Interior air pressure inside the vessel was maintained at 25kPa above

atmospheric pressure. The temperature of the contents of the vessel rose to 52°C after a period of three days, whereupon the administration of air to the contents of the vessel was discontinued.

The contents of the vessel were then subjected to conditions under which anaerobic digestion occurs. A liquid digestate derived from an earlier anaerobic digestion of a previous batch of organic waste material was delivered to the vessel. Recirculation of the liquid digestate through the vessel was operated continuously for a period of 8 days. Biogas was generated after a short period. The volume of biogas generated during the anaerobic digestion stage peaked at about 9 m³/m³.day with an average production rate of 7 m³/m³.day. The average methane content of the biogas varied from 40-60%.

Following anaerobic digestion, the liquid digestate was drained from the vessel and air was administered to the vessel at a flow rate of 150L/hr. Interior air pressure inside the vessel was maintained at 25kPa above atmospheric pressure. Conditions for aerobic composting were maintained for five days.

After five days the resulting compost was removed from the vessel. Internal temperatures of the compost were monitored for four consecutive days to assess the stability of the compost. The internal temperature did not exceed 24°C, thus indicating desired stability.

The compost was analysed for key parameters corresponding to requirements of Australian Standards AS 4454-2000 *Composts, Soil Conditioners and Mulches*. The results and comparative results are shown in the following Table. The C:N ratio of the resulting compost was 19.

Table

Characteristic (units)	AS 4454-2000 requirements	Compost
P (% dry mass)	N/A	0.6
Nitrogen-ammonium (mg/L in extract)	<300	170
Nitrogen-nitrate (mg/L in extract)	>100 (if plant nutrition claimed)	175
Total N (% dry matter)	≥ 0.8 if plant nutrition claimed	1.3
C:N ratio	<20	19
Total C (% dry matter)	≥ 25	25
Temperature	$\leq 40^{\circ}\text{C}$ for four days	23°C

Modifications and variations as would be apparent to a skilled addressee are deemed to

5 be within the scope of the present invention.

CLAIMS

1 An organic waste material treatment process for organic waste material
received in a vessel comprising the steps of:

a) subjecting the contents of the vessel to conditions under which aerobic
5 composting of the contents of the vessel will proceed in order to raise the
temperature of the contents of the vessel to between 15-75°C to promote
anaerobic digestion of the contents;

b) depleting oxygen in the vessel to create conditions suitable for anaerobic digestion
of the contents to proceed;

10 c) adding an anaerobic bacterial inoculum to the contents of the vessel;

d) anaerobically digesting the contents of the vessel;

e) separating gaseous byproducts from residues resulting from step d);

f) removing at least a portion of residual water from the vessel;

15 g) evenly distributing air to the residues in the vessel to create conditions suitable
for aerobic composting of the residues to proceed without agitating the contents of
the vessel;

h) aerobically composting the residues by action of aerobic bacteria; and

i) recovering compost resulting from step h) from the vessel.

20 2. The organic waste material treatment process according to claim 1, characterised
in that the temperature of the contents of the vessel is raised to at least 50 °C
before commencement of step d).

3. The organic waste material treatment process according to claim 1 or claim 2,
characterised in that air is administered to the contents of the vessel before
commencement of step a).

- 4 The organic waste material treatment process according to claim 3, characterised
in that air is administered to the contents of the vessel at a pressure of between 1-
1000kPa above atmospheric pressure to ensure even penetration of the contents of
the vessel by the air.
- 5 5. The organic waste material treatment process according to claim 4, characterised
in that air is administered to the contents of the vessel at a pressure of between 5 -
50 kPa above atmospheric pressure to ensure even penetration of the contents of
the vessel by the air.
- 6 The organic waste material treatment process according to claim 4 or claim 5,
10 characterised in that air is administered to the contents of the vessel at about 25
kPa above atmospheric pressure
- 7 The organic waste material treatment process according to any one of claims 1 to
6, characterised in that water is added to the contents of the vessel to adjust a
moisture content of the contents of the vessel to between about 40 - 60 % wet
15 weight (w/w) before commencement of step a).
- 8 The organic waste material treatment process according to any one of claims 1 to
7, characterised in that oxygen in the vessel is depleted at step b) by sealing the
vessel and ceasing administration of air to the contents of the vessel, thereby
providing no further oxygen reserves for aerobic bacteria therein, thus causing the
20 aerobic bacteria to consume the oxygen remaining in the vessel.
9. The organic waste material treatment process according to any one of claims 1 to
8, characterised in that air is administered to the residues at step g) at a pressure of
between 1-1000 kPa above atmospheric pressure to ensure even penetration of the
residues by the air.

- 10 The organic waste material treatment process according to claim 9, characterised
in that air is administered to the residues at step g) at a pressure of between 5 - 50
kPa above atmospheric pressure to ensure even penetration of the residues by the
air
- 5 11 The organic waste material treatment process according to claim 9 or claim 10,
characterised in that air is administered to the residues at step g) at a pressure of
about 25 kPa above atmospheric pressure to ensure even penetration of the
residues by the air.
- 10 12 The organic waste material treatment process according to any one of claims 1 to
11, characterised in that the portion of water removed from the vessel in step f)
results in a moisture content of the residues of between 40 - 60 % wet weight
(w/w)
- 15 13. The organic waste material treatment process according to any one of claims 1 to
12, characterised in that the gaseous byproducts separated from the residues in
step e) include methane.
- 14 The organic waste material treatment process according to any one of claims 1 to
13, characterised in that the compost resulting from step h) has been aerobically
stabilised
- 15 An organic waste material treatment process for organic waste material received
20 in a plurality of interconnected vessels comprising the steps of:
- a) subjecting the contents of the or each vessel to conditions under which aerobic
composting of contents will proceed in order to raise the temperature of the
contents to between 15-75°C to promote anaerobic digestion of the contents;
- b) depleting oxygen in the or each vessel to create conditions suitable for anaerobic
25 digestion of the contents to proceed;

- c) adding water received from an interconnected vessel to the or each vessel to create conditions suitable for anaerobic digestion of the contents to proceed in the or each vessel, whereby the contents of the interconnected vessel has already undergone anaerobic digestion and the water contains an anaerobic bacterial inoculum;
 - d) anaerobically digesting the contents of the or each vessel;
 - e) separating gaseous byproducts from residues resulting from step d);
 - f) removing at least a portion of the water from the or each vessel and transferring the portion of the water to another interconnected vessel for use in step c);
 - g) evenly distributing air to the residues in the or each vessel to create conditions suitable for aerobic composting of the residues to proceed without agitating the contents of the vessel;
 - h) aerobically composting the residues; and
 - i) recovering compost resulting from step h) from the or each vessel
- 15 16 The organic waste material treatment process according to claim 15, characterised in that the temperature of the contents of the or each vessel is raised to at least 50 °C before commencement of step d).
- 17 The organic waste material treatment process according to claim 15 or claim 16, characterised in that air is administered to the contents of the or each vessel before commencement of step a).
- 18 The organic waste material treatment process according to claim 17, characterised in that air is administered to the contents of the or each vessel at a pressure of between 1-1000 kPa above atmospheric pressure to ensure even penetration of the contents of the or each vessel by the air.

- 19 The organic waste material treatment process according to claim 18, characterised in that air is administered to the contents of the or each vessel at a pressure of between 5 - 50 kPa above atmospheric pressure to ensure even penetration of the contents of the or each vessel by the air.
- 5 20 The organic waste material treatment process according to claim 18 or claim 19, characterised in that air is administered to the contents of the or each vessel at about 25 kPa above atmospheric pressure
- 21 The organic waste material treatment process according to any one of claims 15 to 20, characterised in that water is added to the contents of the or each vessel to
10 adjust a moisture content of the contents of the or each vessel to between 40 - 60 % wet weight (w/w) before commencement of step a).
- 22 The organic waste material treatment process according to any one of claims 15 to 21, characterised in that oxygen in the or each vessel is depleted by sealing the or each vessel and ceasing administration of air to the contents of the or each vessel,
15 thereby providing no further oxygen reserves for aerobic bacteria therein, thus causing the aerobic bacteria to consume the oxygen remaining in the or each vessel.
23. The organic waste material treatment process according to any one of claims 15 to 22, characterised in that air is administered to the residues at step g) at a pressure
20 of between 1-1000 kPa above atmospheric pressure to ensure even penetration of the residues by the air.
24. The organic waste material treatment process according to claim 23, characterised in that air is administered to the residues at step g) at a pressure of between 5 -50 kPa above atmospheric pressure to ensure even penetration of the residues by the
25 air.

- 25 The organic waste material treatment process according to claim 23 or claim 24, characterised in that air is administered to the residues at step g) at a pressure of about 25 kPa above atmospheric pressure to ensure even penetration of the residues by the air.
- 5 26 The organic waste material treatment process according to any one of claims 15 to 25, characterised in that the portion of water removed from the or each vessel in step f) results in a moisture content of the residues of between 40 - 60 % wet weight (w/w).
- 10 27 The organic waste material treatment process according to any one of claims 15 to 26, characterised in that the gaseous byproducts separated from the residues in step e) include methane.
- 28 The organic waste material treatment process according to any one of claims 15 to 27, characterised in that the compost resulting from step h) has been aerobically stabilised
- 15 29 A vessel for sequential anaerobic digestion and aerobic composting of organic waste material arranged, in use, to facilitate an organic waste treatment process as claimed in any one of claims 1 to 28, comprising a means for receiving organic waste material, first feed means for supplying water to the vessel and second feed means for supplying air to the vessel, wherein the first and second feed means are arranged to evenly distribute water and air to the organic waste material; the vessel being devoid of any internal agitation means.
- 20 30 The vessel according to claim 29, characterised in that the first and second feed means include a plurality of feeder lines disposed in at least one wall of the vessel to facilitate the supply of air and water evenly to the organic waste material.

- 31 The vessel according to claim 29, characterised in that the first and second feed means includes at least one elongate perforated lance depending from an uppermost wall or a lowermost wall of the vessel to facilitate the supply of air and water evenly to the organic waste material.
- 5 32 The vessel according to any one of claims 29 to 31, characterised in that the vessel is provided with a gas extraction line to extract gases generated in the interior of the vessel during anaerobic digestion of the organic waste material or to extract surplus gases upon completion of aerobic composting of the organic waste material.
- 10 33 The vessel according to any one of claims 29 to 32, characterised in that the vessel is constructed to withstand internal pressures of between about 1-1000 kPa above atmospheric pressure.
- 34 The vessel according to any one of claims 29 to 33, characterised in that the second feed means supplies pressurised air to the vessel in a range of between about 1-1000 kPa above atmospheric pressure such that the pressurised air evenly penetrates the organic waste material.
- 15 35 The vessel according to claim 34, characterised in that the second feed means supplies pressurised air to the vessel in a range of between about 5 - 50 kPa above atmospheric pressure such that the pressurised air evenly penetrates the organic waste material.
- 20 36 The vessel according to claim 34 or claim 35, characterised in that the second feed means supplies pressurised air to the vessel at about 25 kPa above atmospheric pressure.

37 The vessel according to any one of claims 29 to 36, characterised in that the vessel is provided with a drainage means to remove at least a portion of water supplied to the vessel by the first feed means.

38 An apparatus arranged, in use, to facilitate an organic waste material treatment process as claimed in any one of claims 1 to 28, comprising at least one vessel for sequential anaerobic digestion and aerobic composting of organic waste material as claimed in any one of claims 29 to 37, a first recirculation means for recirculating gases extracted from the or each vessel to a first storage means, and a second recirculation means for recirculating water extracted from the or each vessel to a second storage means or an interconnected vessel, wherein the organic waste material in the interconnected vessel is undergoing anaerobic digestion.

39 The apparatus according to claim 38, characterised in that the first storage means is a gas storage tank for storing biogas extracted during anaerobic digestion of the organic waste material in the or each vessel.

40 The apparatus according to claim 38 or claim 39, characterised in that the second storage means is a water storage tank for storing water extracted after anaerobic digestion of the organic waste material in the or each vessel.

41 The apparatus according to claim 40, characterised in that water stored in the water storage tank is recirculated to the interconnected vessel by the second recirculation means, wherein the organic waste material in the interconnected vessel is undergoing anaerobic digestion

42 The apparatus according to claim 40, characterised in that water stored in the water storage tank is subsequently recirculated back to the vessel by the second recirculation means, wherein a subsequent batch of organic waste material is undergoing anaerobic digestion

43 The apparatus according to any one of claims 38 to 42, characterised in that the first recirculation means is interconnected to a dewatering tank, the dewatering tank being arranged, in use, for removal of water from the extracted gases.

44 The apparatus according to claim 43, characterised in that the dewatering tank is
5 interconnected to the second recirculation means for recirculating the water removed from the extracted gases to the second storage means or the interconnected vessel

45 The apparatus according to any one of claims 38 to 44, characterised in that the second storage means is provided with a heating means for heating water stored in
10 the second storage means, the heating means being interconnected by the first recirculation means to the gas storage tank, such that, in use, methane gas stored in the gas storage tank is utilised by the heating means to transfer heat to the water stored in the second storage means.

46 The apparatus according to any one of claims 38 to 45, characterised in that the
15 first recirculation means is interconnected to a heat exchange means, the heat exchange means being arranged, in use, to facilitate transfer of heat energy from hot air extracted from the or each vessel, wherein the organic waste material in the or each vessel is undergoing aerobic composting.

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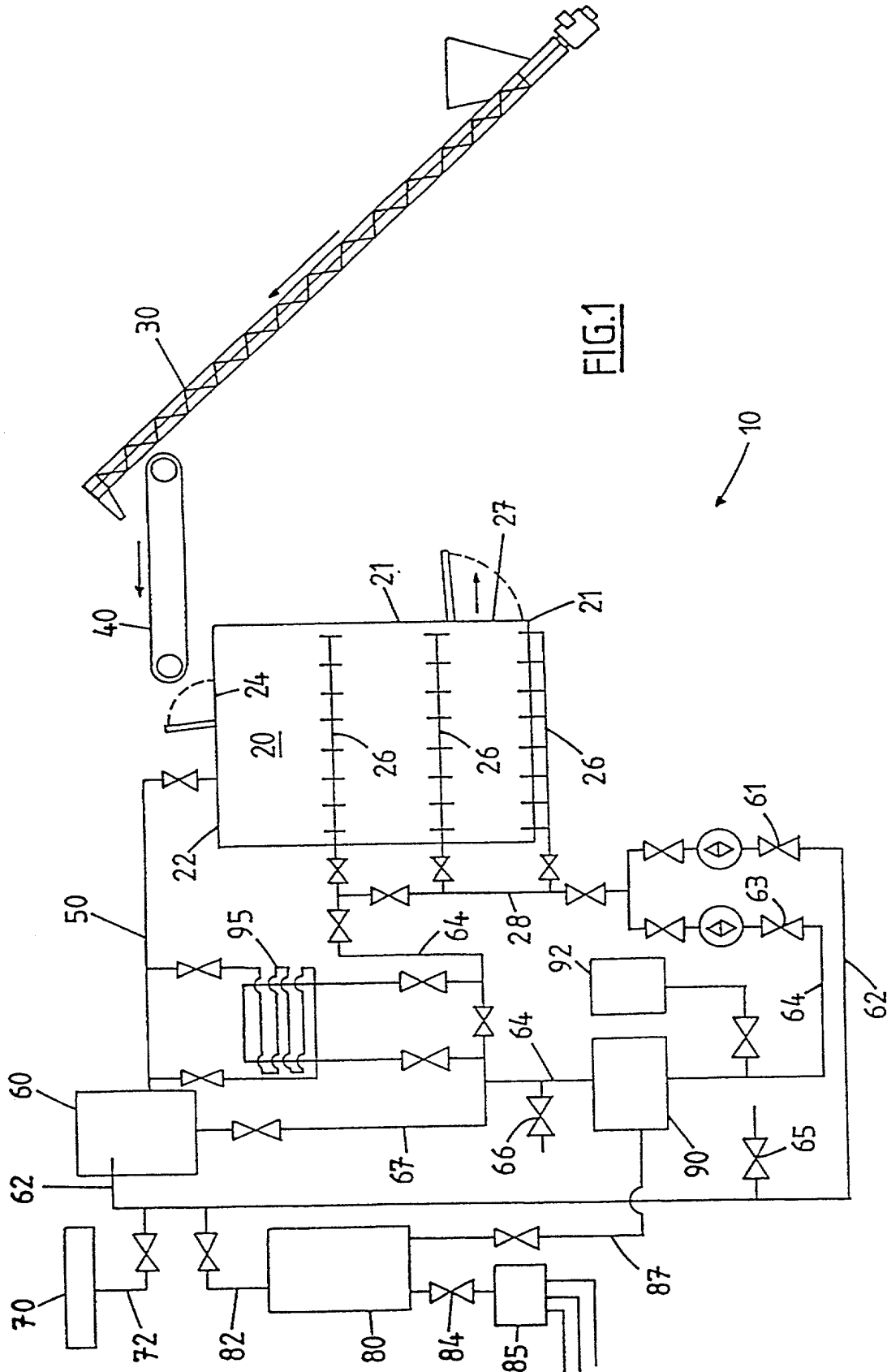


FIG. 1

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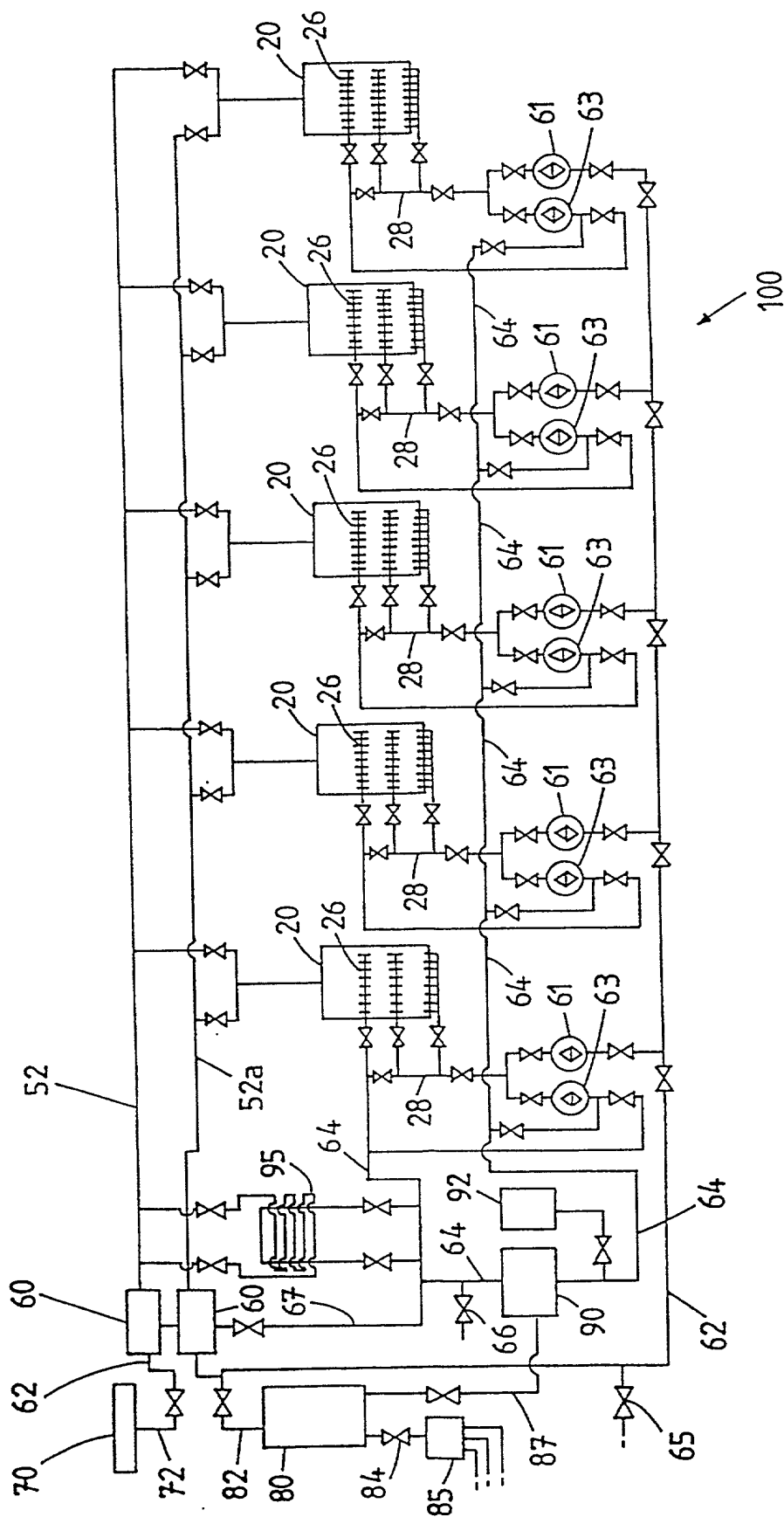


FIG. 2

COMBINED DECLARATION AND POWER OF ATTORNEY

(PATENT - ORIGINAL, DESIGN, NATIONAL STAGE OF PCT)

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type: (check one applicable item below)

- ☐ Original
- ☐ Design
- ☒ National stage of PCT

INVENTORSHIP DECLARATION

My residence, post office address and citizenship are as stated below next to my name, I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: An Organic Waste Material Treatment Process,

SPECIFICATION IDENTIFICATION

the specification of which:

- ☒ is attached hereto.
- ☐ was filed on _____ as Serial No. _____
and was amended on _____ (if applicable).
- NOTE: Amendments filed after the original papers are deposited with the PTO which contain new matter are not accorded a filing date by being referred to in the declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 CFR 1.67
- ☒ was described and claimed in PCT International Application No. PCT/AU0/00865 filed on July 20, 2000 and as amended under PCT Article 19 on _____ (if any).

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Office all known information which is material to patentability as defined in Title 37, Code of Federal Regulations. § 1.56.

- ☐ In compliance with this duty there is attached an information disclosure statement. 37 CFR 1.97.

PRIORITY CLAIM

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

☐

20031431.011802

☐

no such applications have been filed.

☐

such applications have been filed as follows.

NOTE: Where item (c) is entered above and the International Application which designated the U.S. claimed priority check item (e), enter the details below and make the priority claim

**EARLIEST FOREIGN APPLICATION(S), IF ANY FILED WITHIN 12 MONTHS
(6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION**

Country	Application Number	Date of Filing	Priority Claimed under 37 U.S.C. 119
AUSTRALIA	PQ1740	July 20, 1999	___ Yes ___ No
			___ Yes ___ No
			___ Yes ___ No

**ALL FOREIGN APPLICATION(S), IF ANY FILED MORE THAN 12 MONTHS
(6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION**

POWER OF ATTORNEY

As a named inventor, I hereby appoint the following registered practitioners known as Customer No. 08933 to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

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DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the application or any patent issued thereon.

SIGNATURE(S)

Full name of sole or first inventor, if any Tomasz Rudas

Inventor's signature Tomasz Rudas

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